WP 4.2
Setting SSBmsy via Stochastic Simulation Ensures Consistency with Rebuilding Projections

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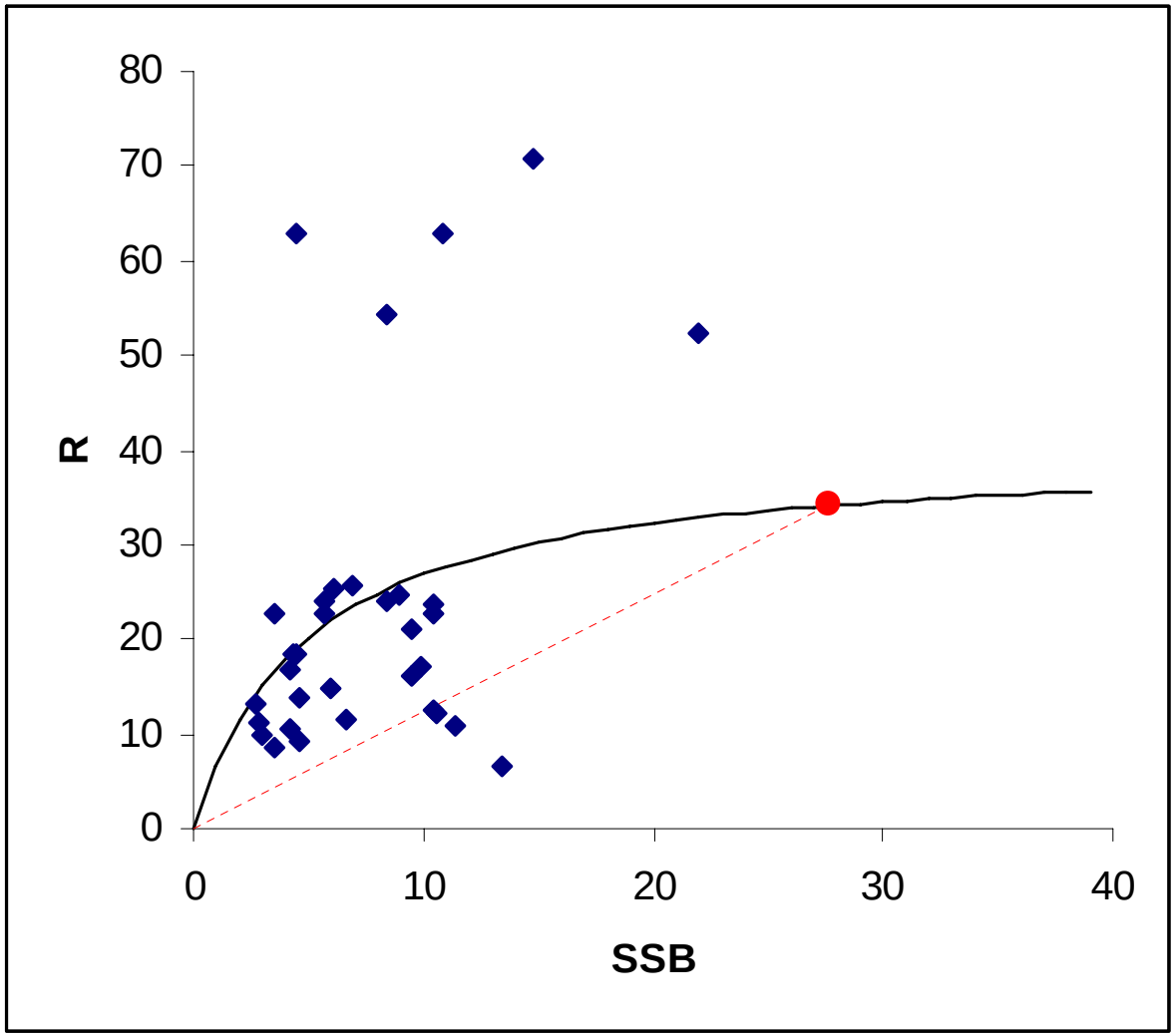
Concept

- Deterministic calculations set MSY reference points
- Stochastic projections determine rebuilding strategies
  - 50% probability typically
- Fishing at Fmsy for many generations in projections does not result in SSBmsy
  - Why this is problematic
  - Solution to ensure consistency

Parametric

- Fmsy=0.435
- SSBmsy=27.7
- MSY=9.27

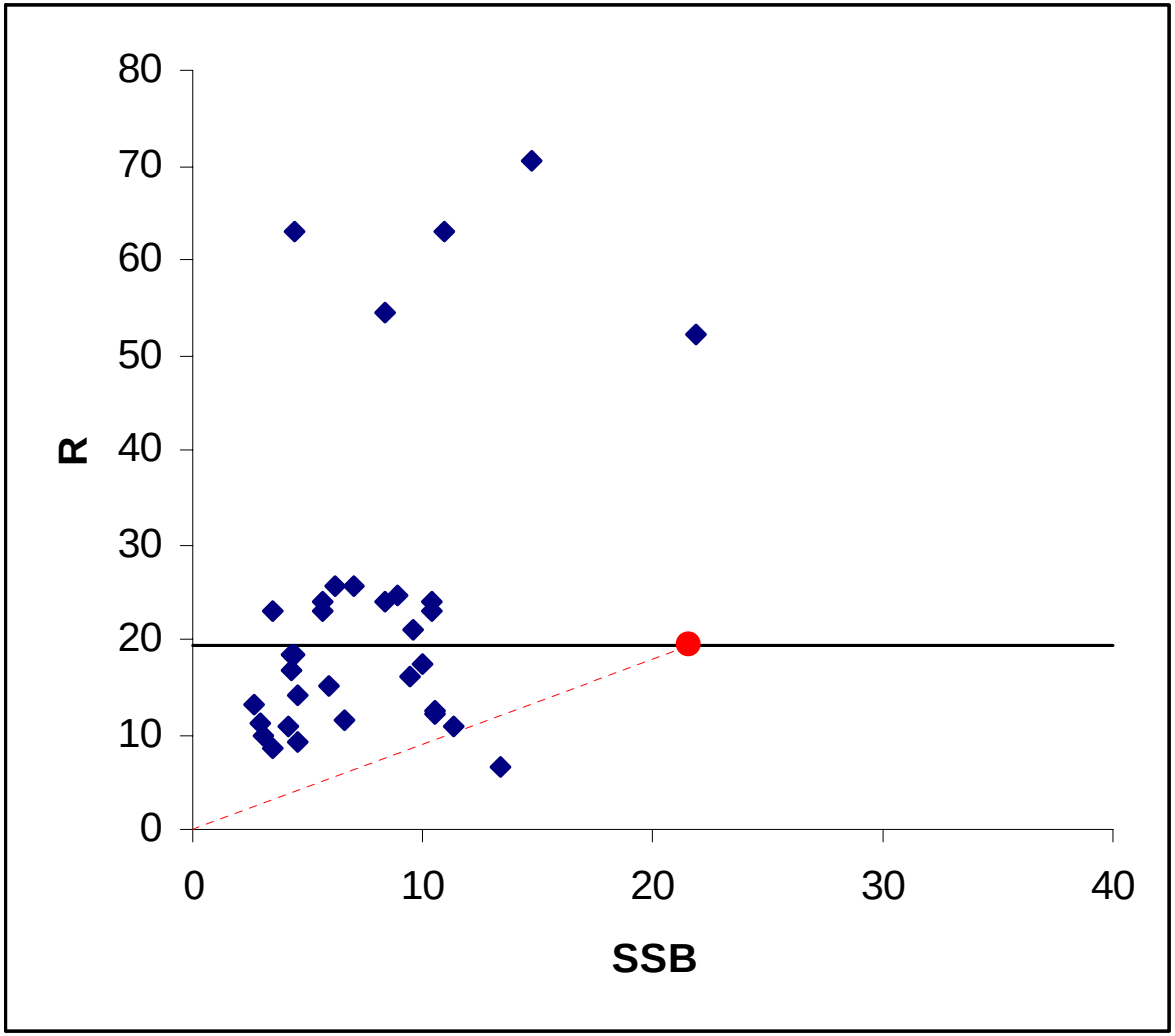
- SSB0=107
- R0=38.5
- h=0.85
- sigma=0.56



Empirical

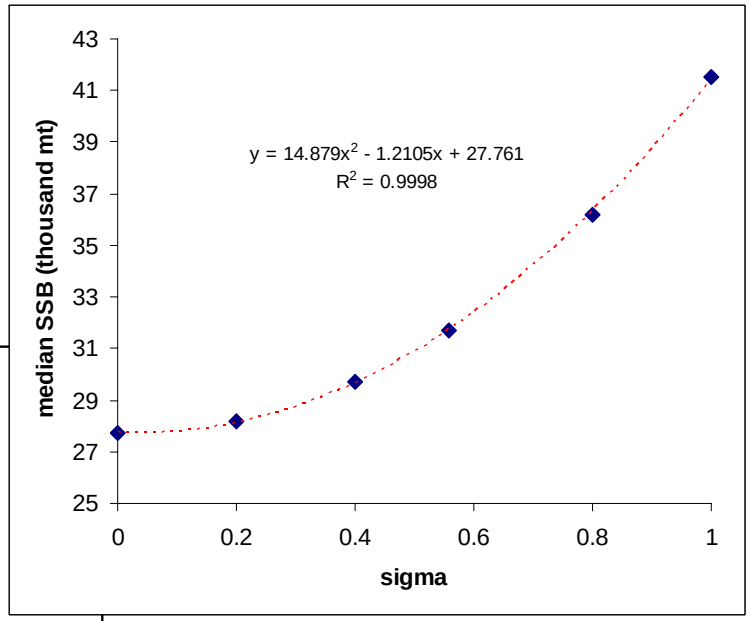
- F40%=0.27
- SSBmsy=21.6
- MSY=4.8

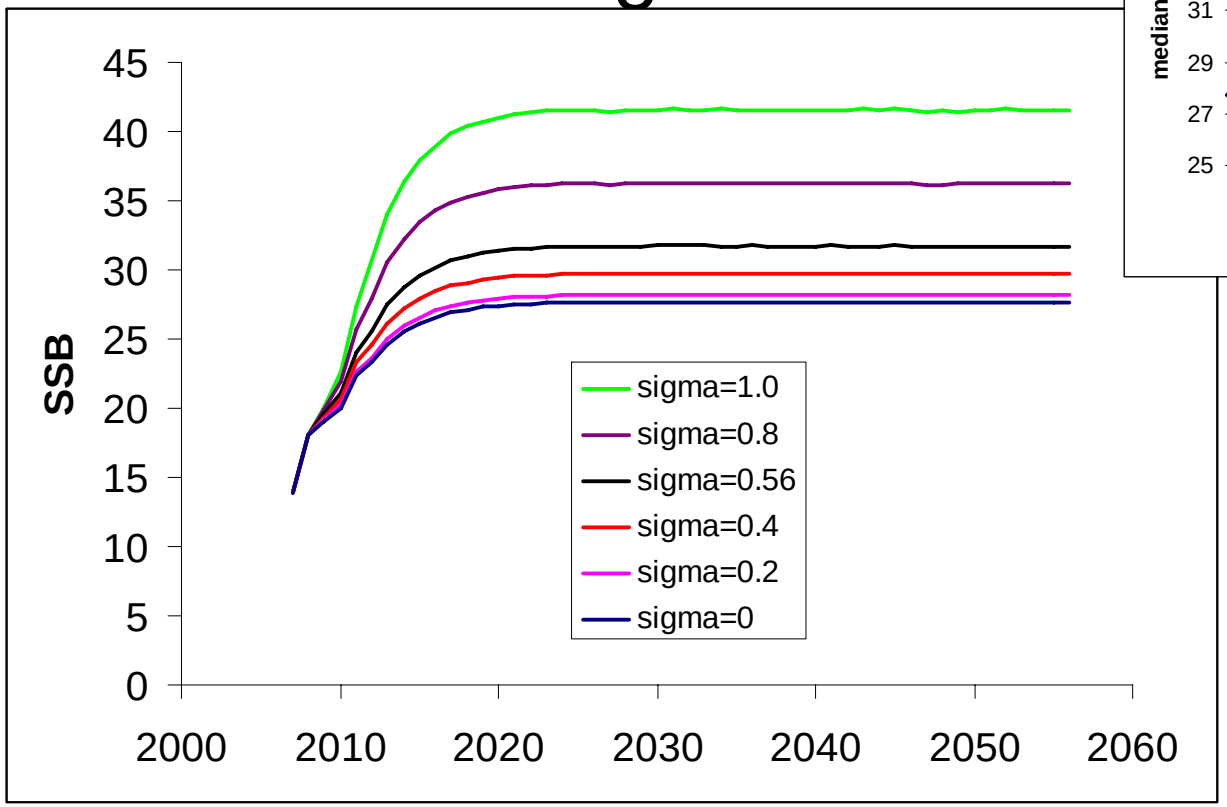
- R0=19.4



Problem

- Parametric
- Fish at Fmsy, median SSB > deterministic value for sigma > 0





Same problem Empirical
Fish at Fmsy get median SSB = 24.8
15% > deterministic

A Modest Proposal

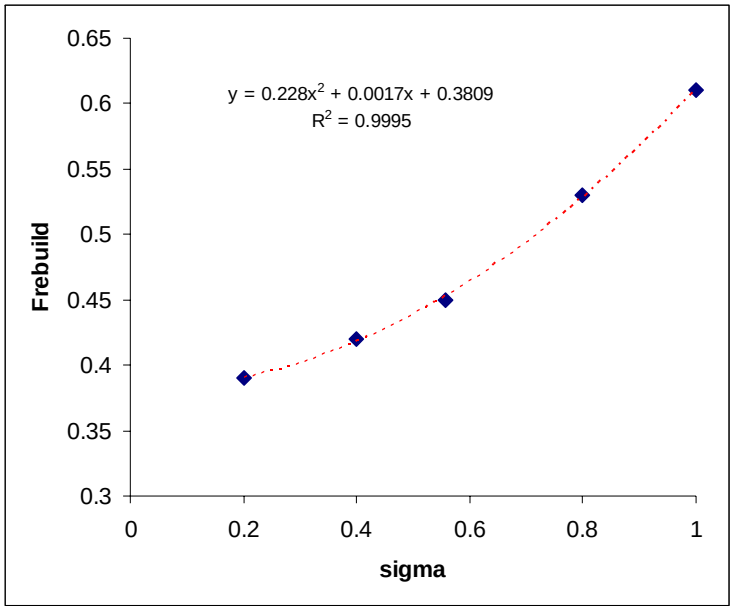
with apologies to Jonathan Swift

- Use deterministic calculations to derive Fmsy (or a proxy)
- Project fishing at Fmsy for many generations
- Resulting median SSB is defined as SSBmsy
  - Same for MSY
- Makes reference points consistent with projections
  - SSBmsy and MSY are emergent properties of stochastic projections

Why is Consistency Important?

- BRPs are used for both status determination and rebuilding programs
- If set SSBmsy using deterministic calcs in parametric example, Frebuild=f(sigma)

sigma	Frebuild
0.2	0.39
0.4	0.42
0.558234	0.45
0.8	0.53
1.0	0.61



Also

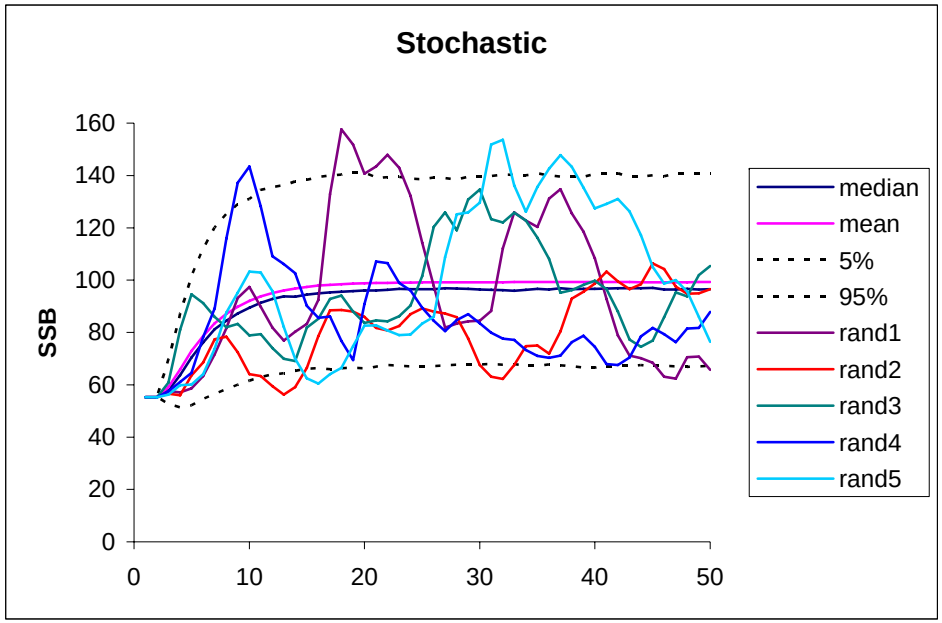
- Median not the only choice for probability of rebuilding
  - Could use 75% (or other value > 50%) probability to be more sure management measures will achieve rebuilding
- Empirical approach can be too optimistic or too pessimistic depending on R estimates and choice of R0

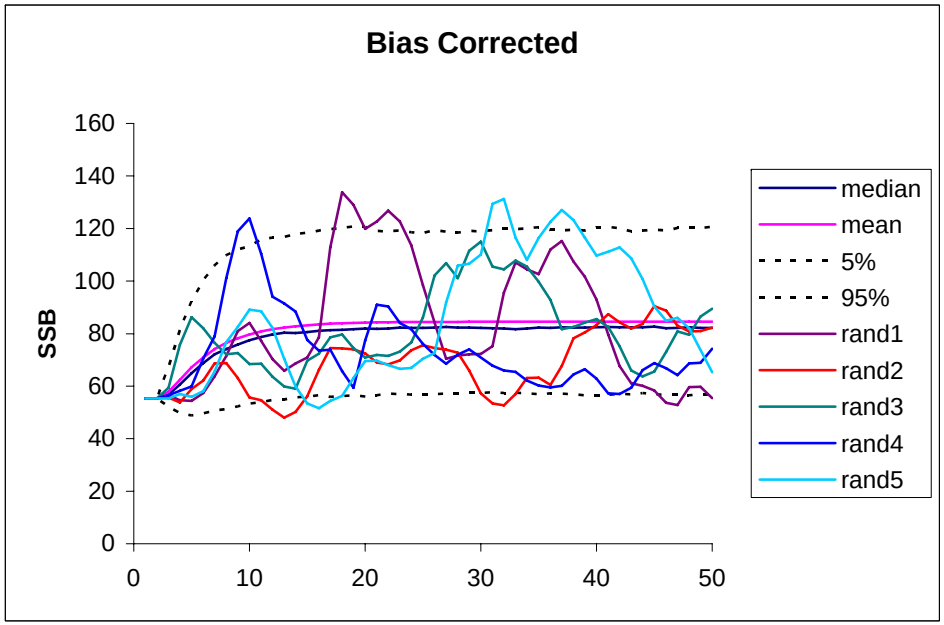
Fmsy via Simulation

- Can extend approach to search for F in projections which produces maximum medium yield
- Will result in higher F
- Fcrash in deterministic approach not present in this extension
- Not recommended

Lognormal Bias Correction

- Standard bias correction for lognormal distribution is to subtract variance/2
  - This correction is for mean
  - Median less than mean
  - Now stock less productive in projections
  - Analytic solution not likely due to how median formed





Other Consistency

- Weight at age and maturity at age vectors
  - These have been changing (see WP 2.1)
  - Want BRPs and projections to use same vectors (easy)
  - What values from assessment?
    - Average of recent 5 years (Pop Dy decision)
  - Reflects current conditions in BRPs
    - May need to change as stocks rebuild

WAA in Plus Group

- Plus group catch weight expected to increase as stock age structure increases due to lower F of rebuilding
- Density dependence may result in slowing of growth
- Not sure how these two will balance in future
- Decision made to use current 5 year average for WAA in plus group
  - Need to revisit this as rebuilding occurs

Short-term vs Long-term Proj

- Some stocks have exhibited recruitment below that expected from SR in recent years
  - Possibly due to environmental conditions
- Should BRP be based on these recruitment levels?
- Should short-term projections be based on these recruitment levels?
- It is possible to separate the two, but need to be careful about making probability statements

Fmsy vs F%SPR

- In the example, Fmsy (0.435) > F40%SPR (0.27) the proxy selected for Fmsy
  - Fmsy corresponds to F29%SPR in this case
- Either
  - F40%SPR is an incorrect proxy
  - Fmsy is too high due to fitting a SR with too high steepness because only overfished obs
- Should address this issue on a case-by-case basis

Recap

- Current approach inconsistent
- Can make BRP and projections consistent by projecting Fmsy for many generations, making SSBmsy an emergent property
- This approach applied for all age based stocks in this meeting

Foolish consistency is the hobgoblin of small minds.
Ralph Waldo Emerson

Parametric and Empirical